a corresponding quantization table scaled by a gain factor for determining a target compression factor;

determining at least one energy measure of the digital image; and

estimating the gain factor as a function of the at least one energy measure, the function being determined experimentally according to the target compression factor.

A' Cont'd

17. A method according to Claim 16, wherein each group of DCT coefficients comprises at least one direct current (DC) coefficient and a plurality of alternating current (AC) coefficients; and wherein estimating the gain factor comprises:

estimating a first number of bits required to encode the AC coefficients of all the blocks using the quantization tables scaled by a pre-set factor as a first function of the at least one energy measure, the first function being determined experimentally according to the target compression factor;

calculating a second number of bits required to encode the DC coefficients of all the blocks using the quantization tables scaled by the pre-set factor;

estimating a basic compression factor provided by the quantization tables scaled by the pre-set factor according to the first number of bits and the second number of bits; and

estimating the gain factor as a second function of the basic compression factor, the second function being determined experimentally according to the target compression factor.

18. A method according to Claim 17, wherein the

first function is a linear function and the second function is a quadratic function.

19. A method according to Claim 17, wherein estimating the basic compression factor comprises:

estimating a third number of bits required to encode control values according to a number of elements of the digital image; and

dividing a sum of the first, second and third number of bits by the number of elements of the digital image.

20. A method according to Claim 17, further comprising:

storing a plurality of sets of parameters representing the second function, each set of parameters being associated with a corresponding value of the target compression factor;

selecting an image quality and determining a current value of the target compression factor as a function of the selected image quality; and

reading the parameters associated with the current value of the target compression factor for estimating the gain factor.

21. A method according to Claim 17, wherein the pre-set factor is determined experimentally according to the target compression factor.

22. A method according to Claim 16, wherein each element of the digital image comprises a luminance component, a first chrominance component, and a second chrominance

component.

23. A method according to Claim 22, wherein the at least one energy measure comprises a total energy measure equal to a sum of an energy measure of the luminance components, an energy measure of the first chrominance components and an energy measure of the second chrominance components.

A1 Con't

24. A method according to Claim 23, wherein determining the at least one energy measure for each type of component comprises:

calculating a horizontal Sobel image and a vertical Sobel image by a convolution of the elements of the digital image comprising a type of component with a horizontal mask and a vertical mask, respectively;

calculating a total Sobel image by summing the horizontal Sobel image and the vertical Sobel image; and

summing an absolute value of each element of the total Sobel image.

25. A method according to Claim 24, wherein at least one quantization table is asymmetric along a horizontal direction and a vertical direction, the method further comprising multiplying the Sobel image associated with the at least one quantization table by a correction factor for compensating the asymmetry of the corresponding quantization table.

26. A method according to Claim 16, further comprising:

providing an incomplete digital image with at least one component missing in each element;

obtaining the digital image from the incomplete digital image;

storing the digital image in a memory and concurrently performing the determining of the at least one energy measure and the estimating of the gain factor; and

reading the digital image from the memory for performing the splitting of the digital image and the quantizing of the DCT coefficients.

27. A method according to Claim 16, further comprising:

providing an incomplete digital image with at least one component missing in each element;

obtaining the digital image from the incomplete digital image for performing the determining of the at least one energy measure and the estimating of the gain factor; and

obtaining the digital image from the incomplete digital image again for performing the splitting of the digital image and the quantizing of the DCT coefficients.

28. A method for compressing a digital image comprising a matrix of elements, each element comprising a plurality of digital components of different types for representing a pixel, the method comprising:

splitting the digital image into a plurality of blocks, and calculating for each block a group of discrete cosine transform (DCT) coefficients for the digital components of different types, each group of DCT coefficients comprising at least one direct current (DC) coefficient and a plurality

of alternating current (AC) coefficients;

quantizing the DCT coefficients for each block using a corresponding quantization table scaled by a gain factor for determining a target compression factor;

determining at least one energy measure of the digital image; and

estimating the gain factor as a function of the at least one energy measure by

estimating a first number of bits required to encode the AC coefficients of all the blocks using the quantization tables scaled by a pre-set factor as a first function of the at least one energy measure,

calculating a second number of bits required to encode the DC coefficients of all the blocks using the quantization tables scaled by the pre-set factor,

estimating a basic compression factor provided by the quantization tables scaled by the pre-set factor according to the first number of bits and the second number of bits, and

estimating the gain factor as a second function of the basic compression factor.

29. A method according to Claim 28, wherein the first and second functions are determined experimentally according to the target compression factor.

30. A method according to Claim 28, wherein the first function is a linear function and the second function is a quadratic function.

31. A method according to Claim 28, wherein estimating the basic compression factor comprises:

estimating a third number of bits required to encode control values according to a number of elements of the digital image; and

dividing a sum of the first, second and third number of bits by the number of elements of the digital image.

A1 Cont'd

32. A method according to Claim 28, wherein each element of the digital image comprises a luminance component, a first chrominance component, and a second chrominance component.

33. A method according to Claim 32, wherein the at least one energy measure comprises a total energy measure equal to a sum of an energy measure of the luminance components, an energy measure of the first chrominance components and an energy measure of the second chrominance components.

34. A method according to Claim 33, wherein determining the at least one energy measure for each type of component comprises:

calculating a horizontal Sobel image and a vertical Sobel image by a convolution of the elements of the digital image comprising a type of component with a horizontal mask and a vertical mask, respectively;

calculating a total Sobel image by summing the horizontal Sobel image and the vertical Sobel image; and

summing an absolute value of each element of the total Sobel image.

35. A device for compressing a digital image comprising a matrix of elements, each element comprising a plurality of digital components of different types for representing a pixel, the device comprising:

discrete cosine transform (DCT) means for splitting the digital image into a plurality of blocks, and calculating for each block a group of coefficients for the digital components of different types;

quantization means connected to said DCT means for quantizing the DCT coefficients for each block using a corresponding quantization table scaled by a gain factor for achieving a target compression factor;

energy means for determining at least one energy measure of the digital image; and

estimation means for estimating the gain factor as a function of the at least one energy measure, the function being determined experimentally according to the target compression factor.

36. A device according to Claim 35, wherein said DCT means and said quantization means define a compression unit; wherein said estimation means comprises a processor for controlling compression of the digital image; the device further comprising:

a memory for storing the quantization tables; and

communication means for connecting said compression unit, said memory, said energy means and said processor together, said processor estimating the gain factor based upon a program stored in said memory.

37. A device according to Claim 35, wherein each

group of DCT coefficients comprises at least one direct current (DC) coefficient and a plurality of alternating current (AC) coefficients; and wherein said estimation means is for:

estimating a first number of bits required to encode the AC coefficients of all the blocks using the quantization tables scaled by a pre-set factor as a first function of the at least one energy measure, the first function being determined experimentally according to the target compression factor;

calculating a second number of bits required to encode the DC coefficients of all the blocks using the quantization tables scaled by the pre-set factor;

estimating a basic compression factor provided by the quantization tables scaled by the pre-set factor according to the first number of bits and the second number of bits; and

estimating the gain factor as a second function of the basic compression factor, the second function being determined experimentally according to the target compression factor.

38. A device according to Claim 37, wherein the first function is a linear function and the second function is a quadratic function.

39. A device according to Claim 37, wherein said estimation means for estimating the basic compression factor is further for:

estimating a third number of bits required to encode control values according to a number of elements of the digital image; and

dividing a sum of the first, second and third number of bits by the number of elements of the digital image.

40. A device according to Claim 35, wherein each element of the digital image comprises a luminance component, a first chrominance component, and a second chrominance component.

41. A device according to Claim 40, wherein the at least one energy measure comprises a total energy measure equal to a sum of an energy measure of the luminance components, an energy measure of the first chrominance components and an energy measure of the second chrominance components.

42. A device according to Claim 41, wherein said energy means is for:

calculating a horizontal Sobel image and a vertical Sobel image by a convolution of the elements of the digital image comprising a type of component with a horizontal mask and a vertical mask, respectively;

calculating a total Sobel image by summing the horizontal Sobel image and the vertical Sobel image; and

summing an absolute value of each element of the total Sobel image.

43. A digital still camera comprising:

an image acquisition unit for transmitting light corresponding to an image of scene;

a sensor unit connected to said image acquisition unit for providing a digital image of scene, the digital image

comprising a matrix of elements, each element comprising a plurality of digital components of different types for representing a pixel; and

a control device for compressing the digital image and comprising

a discrete cosine transform (DCT) circuit for splitting the digital image into a plurality of blocks, and calculating for each block a group of discrete cosine transform (DCT) coefficients for the digital components of different types,

a quantization circuit connected to said DCT circuit for quantizing the DCT coefficients for each block using a corresponding quantization table scaled by a gain factor for achieving a target compression factor,

an energy circuit for determining at least one energy measure of the digital image, and

a processor for estimating the gain factor as a function of the at least one energy measure, the function being determined experimentally according to the target compression factor.

44. A digital still camera according to Claim 43, wherein said DCT circuit and said quantization circuit define a compression unit; the device further comprising:

a memory for storing the quantization tables; and

a communication bus for connecting said compression unit, said memory, said energy circuit and said processor together, said processor estimating the gain factor based upon a program stored in said memory.

45. A digital still camera according to Claim 43, wherein each group of DCT coefficients comprises at least one DC coefficient and a plurality of AC coefficients; and wherein said estimation circuit is for:

estimating a first number of bits required to encode the AC coefficients of all the blocks using the quantization tables scaled by a pre-set factor as a first function of the at least one energy measure, the first function being determined experimentally according to the target compression factor;

calculating a second number of bits required to encode the DC coefficients of all the blocks using the quantization tables scaled by the pre-set factor;

estimating a basic compression factor provided by the quantization tables scaled by the pre-set factor according to the first number of bits and the second number of bits; and

estimating the gain factor as a second function of the basic compression factor, the second function being determined experimentally according to the target compression factor.

46. A digital still camera according to Claim 45, wherein the first function is a linear function and the second function is a quadratic function.

47. A digital still camera according to Claim 45, wherein said estimation circuit for estimating the basic compression factor is further for:

estimating a third number of bits required to encode control values according to a number of elements of the digital image; and

dividing a sum of the first, second and third number of bits by the number of elements of the digital image.

48. A digital still camera according to Claim 43, wherein each element of the digital image comprises a luminance component, a first chrominance component, and a second chrominance component.

49. A digital still camera according to Claim 48, wherein the at least one energy measure comprises a total energy measure equal to a sum of an energy measure of the luminance components, an energy measure of the first chrominance components and an energy measure of the second chrominance components.

50. A digital still camera according to Claim 49, wherein said energy circuit is for:

calculating a horizontal Sobel image and a vertical Sobel image by a convolution of the elements of the digital image comprising a type of component with a horizontal mask and a vertical mask, respectively;

calculating a total Sobel image by summing the horizontal Sobel image and the vertical Sobel image; and

summing an absolute value of each element of the total Sobel image.

**REMARKS**

It is believed that all of the claims are patentable over the prior art. For better readability and the Examiner's convenience, the newly submitted claims differ from the translated counterpart claims which are being canceled. The